Regulations (Standards - 29 CFR)

General requirements. - 1926.403

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- **Part Number:** 1926
- **Part Title:** Safety and Health Regulations for Construction
- **Subpart:** K
- **Subpart Title:** Electrical
- **Standard Number:** 1926.403
- **Title:** General requirements.

1926.403(a)

Approval. All electrical conductors and equipment shall be approved.

1926.403(b)

Examination, installation, and use of equipment -

1926.403(b)(1)

Examination. The employer shall ensure that electrical equipment is free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined on the basis of the following considerations:

1926.403(b)(1)(i)

Suitability for installation and use in conformity with the provisions of this subpart. Suitability of equipment for an identified purpose may be evidenced by listing, labeling, or certification for that identified purpose.

1926.403(b)(1)(ii)

Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided.

1926.403(b)(1)(iii)

Electrical insulation.

1926.403(b)(1)(iv)

Heating effects under conditions of use.

..1926.403(b)(1)(v)

1926.403(b)(1)(v)

Arcing effects.

1926.403(b)(1)(vi)

Classification by type, size, voltage, current capacity, specific use.

1926.403(b)(1)(vii)

Other factors which contribute to the practical safeguarding of employees using or likely to come in contact with the equipment.

1926.403(b)(2)

Installation and use. Listed, labeled, or certified equipment shall be installed and used in accordance with instructions included in the listing, labeling, or certification.

1926.403(c)

Interrupting rating. Equipment intended to break current shall have an interrupting rating at system voltage sufficient for the current that must be interrupted.

1926.403(d)

Mounting and cooling of equipment -

1926.403(d)(1)

Mounting. Electric equipment shall be firmly secured to the surface on which it is mounted. Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials shall not be used.

..1926.403(d)(2)

1926.403(d)(2)

Cooling. Electrical equipment which depends upon the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room air flow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air. Electrical equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

1926.403(e)

Splices. Conductors shall be spliced or joined with splicing devices designed for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be so spliced or joined as to be mechanically and electrically secure without solder and then soldered. All splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors or with an insulating device designed for the purpose.

1926.403(f)

Arcing parts. Parts of electric equipment which in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

1926.403(g)

Marking. Electrical equipment shall not be used unless the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified is placed on the equipment and unless other markings are provided giving voltage, current, wattage, or other ratings as necessary. The marking shall be of sufficient durability to withstand the environment involved.

..1926.403(h)

1926.403(h)

Identification of disconnecting means and circuits. Each disconnecting means required by this subpart for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. These markings shall be of sufficient durability to withstand the environment involved.

1926.403(i)

600 Volts, nominal, or less. This paragraph applies to equipment operating at 600 volts, nominal, or less.

1926.403(i)(1)

Working space about electric equipment. Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

1926.403(i)(1)(i)

Working clearances. Except as required or permitted elsewhere in this subpart, the dimension of the working space in the direction of access to live parts operating at 600 volts or less and likely to require examination, adjustment, servicing, or maintenance while alive shall not be less than indicated in Table K-1. In addition to the dimensions shown in Table K-1, workspace shall not be less than 30 inches (762 mm) wide in front of the electric equipment. Distances shall be measured from the live parts if they are exposed, or from the enclosure front or opening if the live parts are enclosed. Walls constructed of concrete, brick, or tile are considered to be grounded. Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts such as fuses or switches on the back and where all connections are accessible from locations other than the back.

TABLE K-1 - Working Clearances

Nominal voltage to ground	Minimum clear distance for conditions(1)		
	(a)	(b)	(c)
	Feet(2)	Feet(2)	Feet(2)
0-150	3	3	3

151-600	3	3 1/2	4

Footnote(1) Conditions (a), (b), and (c) are as follows: [a] Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts. [b] Exposed live parts on one side and grounded parts on the other side. [c] Exposed live parts on both sides of the workplace [not guarded as provided in Condition (a)] with the operator between.

Footnote(2) Note: For International System of Units (SI): one foot=0.3048m.

..1926.403(i)(1)(ii)

1926.403(i)(1)(ii)

Clear spaces. Working space required by this subpart shall not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, shall be guarded.

1926.403(i)(1)(iii)

Access and entrance to working space. At least one entrance shall be provided to give access to the working space about electric equipment.

1926.403(i)(1)(iv)

Front working space. Where there are live parts normally exposed on the front of switchboards or motor control centers, the working space in front of such equipment shall not be less than 3 feet (914 mm).

1926.403(i)(1)(v)

Headroom. The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers shall be 6 feet 3 inches (1.91 m).

1926.403(i)(2)

Guarding of live parts.

1926.403(i)(2)(i)

Except as required or permitted elsewhere in this subpart, live parts of electric equipment operating at 50 volts or more shall be guarded against accidental contact by cabinets or other forms of enclosures, or by any of the following means:

1926.403(i)(2)(i)(A)

By location in a room, vault, or similar enclosure that is accessible only to qualified persons.

..1926.403(i)(2)(i)(B)

1926.403(i)(2)(i)(B)

By partitions or screens so arranged that only qualified persons will have access to the space

within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them.

1926.403(i)(2)(i)(C)

By location on a balcony, gallery, or platform so elevated and arranged as to exclude unqualified persons.

1926.403(i)(2)(i)(D)

By elevation of 8 feet (2.44 m) or more above the floor or other working surface and so installed as to exclude unqualified persons.

1926.403(i)(2)(ii)

In locations where electric equipment would be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.

1926.403(i)(2)(iii)

Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

1926.403(j)

Over 600 volts, nominal.

1926.403(j)(1)

General. Conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all applicable provisions of paragraphs (a) through (g) of this section and with the following provisions which supplement or modify those requirements. The provisions of paragraphs (j)(2), (j)(3), and (j)(4) of this section do not apply to equipment on the supply side of the service conductors.

..1926.403(j)(2)

1926.403(j)(2)

Enclosure for electrical installations. Electrical installations in a vault, room, closet or in an area surrounded by a wall, screen, or fence, access to which is controlled by lock and key or other equivalent means, are considered to be accessible to qualified persons only. A wall, screen, or fence less than 8 feet (2.44 m) in height is not considered adequate to prevent access unless it has other features that provide a degree of isolation equivalent to an 8-foot (2.44-m) fence. The entrances to all buildings, rooms or enclosures containing exposed live parts or exposed conductors operating at over 600 volts, nominal, shall be kept locked or shall be under the observation of a qualified person at all times.

1926.403(j)(2)(i)

Installations accessible to qualified persons only. Electrical installations having exposed live parts shall be accessible to qualified persons only and shall comply with the applicable provisions of paragraph (j)(3) of this section.

1926.403(j)(2)(ii)

Installations accessible to unqualified persons. Electrical installations that are open to unqualified persons shall be made with metal-enclosed equipment or shall be enclosed in a vault or in an area, access to which is controlled by a lock. Metal-enclosed switchgear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment shall be marked with appropriate caution signs. If equipment is exposed to physical damage from vehicular traffic, guards shall be provided to prevent such damage. Ventilating or similar openings in metal-enclosed equipment shall be designed so that foreign objects inserted through these openings will be deflected from energized parts.

..1926.403(j)(3)

1926.403(j)(3)

Workspace about equipment. Sufficient space shall be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment. Where energized parts are exposed, the minimum clear workspace shall not be less than 6 feet 6 inches (1.98 m) high (measured vertically from the floor or platform), or less than 3 feet (914 mm) wide (measured parallel to the equipment). The depth shall be as required in Table K-2. The workspace shall be adequate to permit at least a 90-degree opening of doors or hinged panels.

1926.403(j)(3)(i)

Working space. The minimum clear working space in front of electric equipment such as switchboards, control panels, switches, circuit breakers, motor controllers, relays, and similar equipment shall not be less than specified in Table K-2 unless otherwise specified in this subpart. Distances shall be measured from the live parts if they are exposed, or from the enclosure front or opening if the live parts are enclosed. However, working space is not required in back of equipment such as deadfront switchboards or control assemblies where there are no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on de-energized parts on the back of enclosed equipment, a minimum working space of 30 inches (762 mm) horizontally shall be provided.

TABLE K-2 - Minimum Depth of Clear Working Space in Front of Electric Equipment

Nominal voltage to ground	Conditions(1)		
	(a)	(b)	(c)
	Feet(2)	Feet(2)	Feet(2)
601 to 2,500	3	4	5
2,501 to 9,000	4	5	6
9,001 to 25,000	5	6	9
25,001 to 75 kV	6	8	10
Above 75kV	8	10	12

Footnote(1) Conditions (a), (b), and (c) are as follows:

1926.403(j)(3)(i)(a)

Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating materials. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.

1926.403(j)(3)(i)(b)

Exposed live parts on one side and grounded parts on the other side. Walls constructed of concrete, brick, or tile are considered to be grounded surfaces.

1926.403(j)(3)(i)(c)

Exposed live parts on both sides of the workspace [not guarded as provided in Condition (a)] with the operator between.

Footnote(2) NOTE: For SI units: one foot=0.3048 m.

..1926.403(j)(3)(ii)

1926.403(j)(3)(ii)

Lighting outlets and points of control. The lighting outlets shall be so arranged that persons changing lamps or making repairs on the lighting system will not be endangered by live parts or other equipment. The points of control shall be so located that persons are not likely to come in contact with any live part or moving part of the equipment while turning on the lights.

1926.403(j)(3)(iii)

Elevation of unguarded live parts. Unguarded live parts above working space shall be maintained at elevations not less than specified in Table K-3.

TABLE K-3 - Elevation of Unguarded Energized Parts Above Working Space

Nominal voltage between phases	Minimum Elevation
601-7,500	8 feet 6 inches.[1]
7,501-35,000	9 feet.
Over 35kV	9 feet+0.37 inches per kV above 35kV.

Footnote(1) NOTE: For SI units: one inch=25.4 mm; one foot=0.3048 m.

1926.403(j)(4)

Entrance and access to workspace. At least one entrance not less than 24 inches (610 mm) wide and 6 feet 6 inches (1.98 m) high shall be provided to give access to the working space about electric equipment. On switchboard and control panels exceeding 48 inches (1.22 m) in width, there shall be one entrance at each end of such board where practicable. Where bare energized parts at any voltage or insulated energized parts above 600 volts are located adjacent to such entrance, they shall be guarded.

[61 FR 5507, Feb. 13, 1996]

Next Standard (1926.404)

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Regulations (Standards - 29 CFR)

General requirements. - 1910.303

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- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** S
- **Subpart Title:** Electrical
- **Standard Number:** 1910.303
- **Title:** General requirements.

1910.303(a)

Approval. The conductors and equipment required or permitted by this subpart shall be acceptable only if approved, as defined in Sec. 1910.399.

1910.303(b)

Examination, installation, and use of equipment --

1910.303(b)(1)

Examination. Electric equipment shall be free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined using the following considerations:

1910.303(b)(1)(i)

Suitability for installation and use in conformity with the provisions of this subpart;

Note to paragraph (b)(1)(i) of this section: Suitability of equipment for an identified purpose may be evidenced by listing or labeling for that identified purpose.

1910.303(b)(1)(ii)

Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided;

1910.303(b)(1)(iii)

Wire-bending and connection space;

1910.303(b)(1)(iv)

Electrical insulation;

1910.303(b)(1)(v)

Heating effects under all conditions of use;

1910.303(b)(1)(vi)

Arcing effects;

1910.303(b)(1)(vii)

Classification by type, size, voltage, current capacity, and specific use; and

1910.303(b)(1)(viii)

Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment.

1910.303(b)(2)

Installation and use. Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

1910.303(b)(3)

Insulation integrity. Completed wiring installations shall be free from short circuits and from grounds other than those required or permitted by this subpart.

1910.303(b)(4)

Interrupting rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

1910.303(b)(5)

Circuit impedance and other characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without the occurrence of extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors, or between any circuit conductor and the grounding conductor or enclosing metal raceway.

1910.303(b)(6)

Deteriorating agents. Unless identified for use in the operating environment, no conductors or equipment shall be located in damp or wet locations; where exposed to gases, fumes, vapors, liquids, or other agents that have a deteriorating effect on the conductors or equipment; or where exposed to excessive temperatures.

1910.303(b)(7)

Mechanical execution of work. Electric equipment shall be installed in a neat and workmanlike manner.

1910.303(b)(7)(i)

Unused openings in boxes, raceways, auxiliary gutters, cabinets, equipment cases, or housings shall be effectively closed to afford protection substantially equivalent to the wall of the equipment.

1910.303(b)(7)(ii)

Conductors shall be racked to provide ready and safe access in underground and

subsurface enclosures that persons enter for installation and maintenance.

1910.303(b)(7)(iii)

Internal parts of electrical equipment, including busbars, wiring terminals, insulators, and other surfaces, may not be damaged or contaminated by foreign materials such as paint, plaster, cleaners, abrasives, or corrosive residues.

1910.303(b)(7)(iv)

There shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment, such as parts that are broken, bent, cut, or deteriorated by corrosion, chemical action, or overheating.

1910.303(b)(8)

Mounting and cooling of equipment.

1910.303(b)(8)(i)

Electric equipment shall be firmly secured to the surface on which it is mounted.

Note to paragraph (b)(8)(i) of this section: Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials are not considered secure means of fastening electric equipment.

1910.303(b)(8)(ii)

Electric equipment that depends on the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room airflow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air.

1910.303(b)(8)(iii)

Electric equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

1910.303(c)

Electrical connections --

1910.303(c)(1)

General. Because of different characteristics of dissimilar metals:

1910.303(c)(1)(i)

Devices such as pressure terminal or pressure splicing connectors and soldering lugs shall be identified for the material of the conductor and shall be properly installed and used;

1910.303(c)(1)(ii)

Conductors of dissimilar metals may not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors (such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum) unless the device is identified for the purpose and conditions of use; and

1910.303(c)(1)(iii)

Materials such as solder, fluxes, inhibitors, and compounds, where employed, shall be suitable for the use and shall be of a type that will not adversely affect the conductors, installation, or equipment.

1910.303(c)(2)

Terminals.

1910.303(c)(2)(i)

Connection of conductors to terminal parts shall ensure a good connection without damaging the conductors and shall be made by means of pressure connectors (including set-screw type), solder lugs, or splices to flexible leads. However, No. 10 or smaller conductors may be connected by means of wire binding screws or studs and nuts having upturned lugs or equivalent.

1910.303(c)(2)(ii)

Terminals for more than one conductor and terminals used to connect aluminum shall be so identified.

1910.303(c)(3)

Splices.

1910.303(c)(3)(i)

Conductors shall be spliced or joined with splicing devices identified for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be spliced or joined to be mechanically and electrically secure without solder and then soldered. All splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors or with an insulating device identified for the purpose.

1910.303(c)(3)(ii)

Wire connectors or splicing means installed on conductors for direct burial shall be listed for such use.

1910.303(d)

Arcing parts. Parts of electric equipment that in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

1910.303(e)

Marking --

1910.303(e)(1)

Identification of manufacturer and ratings. Electric equipment may not be used unless the following markings have been placed on the equipment:

1910.303(e)(1)(i)

The manufacturer's name, trademark, or other descriptive marking by which the

organization responsible for the product may be identified; and

1910.303(e)(1)(ii)

Other markings giving voltage, current, wattage, or other ratings as necessary.

1910.303(e)(2)

Durability. The marking shall be of sufficient durability to withstand the environment involved.

1910.303(f)

Disconnecting means and circuits --

1910.303(f)(1)

Motors and appliances. Each disconnecting means required by this subpart for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

1910.303(f)(2)

Services, feeders, and branch circuits. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

1910.303(f)(3)

Durability of markings. The markings required by paragraphs (f)(1) and (f)(2) of this section shall be of sufficient durability to withstand the environment involved.

1910.303(f)(4)

Capable of accepting a lock. Disconnecting means required by this subpart shall be capable of being locked in the open position.

1910.303(f)(5)

Marking for series combination ratings.

1910.303(f)(5)(i)

Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturer, the equipment enclosures shall be legibly marked in the field to indicate that the equipment has been applied with a series combination rating.

1910.303(f)(5)(ii)

The marking required by paragraph (f)(5)(i) of this section shall be readily visible and shall state "Caution -- Series Combination System Rated_____Amperes. Identified Replacement Component Required."

1910.303(g)

600 Volts, nominal, or less. This paragraph applies to electric equipment operating at 600 volts, nominal, or less to ground.

1910.303(g)(1)

Space about electric equipment. Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

1910.303(g)(1)(i)

Working space for equipment likely to require examination, adjustment, servicing, or maintenance while energized shall comply with the following dimensions, except as required or permitted elsewhere in this subpart:

1910.303(g)(1)(i)(A)

The depth of the working space in the direction of access to live parts may not be less than indicated in Table S-1. Distances shall be measured from the live parts if they are exposed or from the enclosure front or opening if they are enclosed;

1910.303(g)(1)(i)(B)

The width of working space in front of the electric equipment shall be the width of the equipment or 762 mm (30 in.), whichever is greater. In all cases, the working space shall permit at least a 90-degree opening of equipment doors or hinged panels; and

1910.303(g)(1)(i)(C)

The work space shall be clear and extend from the grade, floor, or platform to the height required by paragraph (g)(1)(vi) of this section. However, other equipment associated with the electrical installation and located above or below the electric equipment may extend not more than 153 mm (6 in.) beyond the front of the electric equipment.

1910.303(g)(1)(ii)

Working space required by this standard may not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, shall be suitably guarded.

1910.303(g)(1)(iii)

At least one entrance of sufficient area shall be provided to give access to the working space about electric equipment.

1910.303(g)(1)(iv)

For equipment rated 1200 amperes or more and over 1.83 m (6.0 ft) wide, containing overcurrent devices, switching devices, or control devices, there shall be one entrance not less than 610 mm (24 in.) wide and 1.98 m (6.5 ft) high at each end of the working space, except that:

1910.303(g)(1)(iv)(A)

Where the location permits a continuous and unobstructed way of exit travel, one means of exit is permitted; or

1910.303(g)(1)(iv)(B)

Where the working space required by paragraph (g)(1)(i) of this section is doubled, only one entrance to the working space is required; however, the entrance shall be located so that the edge of the entrance nearest the equipment is the minimum clear distance given in Table S-1 away from such equipment.

1910.303(g)(1)(v)

Illumination shall be provided for all working spaces about service equipment, switchboards, panelboards, and motor control centers installed indoors. Additional lighting fixtures are not required where the working space is illuminated by an adjacent light source. In electric equipment rooms, the illumination may not be controlled by automatic means only.

1910.303(g)(1)(vi)

The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers shall be as follows:

1910.303(g)(1)(vi)(A)

For installations built before August 13, 2007, 1.91 m (6.25 ft); and

1910.303(g)(1)(vi)(B)

For installations built on or after August 13, 2007, 1.98 m (6.5 ft), except that where the electrical equipment exceeds 1.98 m (6.5 ft) in height, the minimum headroom may not be less than the height of the equipment.

Table S-1. -- Minimum Depth of Clear Working Space at Electric Equipment, 600 V or Less

Nominal voltage to ground	Minimum clear distance for condition[2 3]					
	Condition A		Condition B		Condition B	
	m	ft	m	ft	m	ft
0-150	[1]0.9	[1]3.0	[1]0.9	[1]3.0	0.9	3.0
151-600	[1]0.9	[1]3.0	1.0	3.5	1.2	4.0

Notes to Table S-1:

1. Minimum clear distances may be 0.7 m (2.5 ft) for installations built before April 16, 1981.
2. Conditions A, B, and C are as follows:

Condition A -- Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.

Condition B -- Exposed live parts on one side and grounded parts on the other side.

Condition C -- Exposed live parts on both sides of the work space (not guarded as provided in Condition A) with the operator between.

3. Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on deenergized parts on the back of enclosed equipment, a minimum working space of 762 mm (30 in.) horizontally shall be provided.

1910.303(g)(1)(vii)

Switchboards, panelboards, and distribution boards installed for the control of light and power circuits, and motor control centers shall be located in dedicated spaces and protected from damage.

1910.303(g)(1)(vii)(A)

For indoor installation, the dedicated space shall comply with the following:

1910.303(g)(1)(vii)(A)(1)

The space equal to the width and depth of the equipment and extending from the floor to a height of 1.83 m (6.0 ft) above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. Unless isolated from equipment by height or physical enclosures or covers that will afford adequate mechanical protection from vehicular traffic or accidental contact by unauthorized personnel or that complies with paragraph (g)(1)(vii)(A)(2) of this section, piping, ducts, or equipment foreign to the electrical installation may not be located in this area;

1910.303(g)(1)(vii)(A)(2)

The space equal to the width and depth of the equipment shall be kept clear of foreign systems unless protection is provided to avoid damage from condensation, leaks, or breaks in such foreign systems. This area shall extend from the top of the electric equipment to the structural ceiling;

1910.303(g)(1)(vii)(A)(3)

Sprinkler protection is permitted for the dedicated space where the piping complies with this section; and

1910.303(g)(1)(vii)(A)(4)

Control equipment that by its very nature or because of other requirements in this subpart must be adjacent to or within sight of its operating machinery is permitted in the dedicated space.

Note to paragraph (g)(1)(vii)(A) of this section: A dropped, suspended, or similar ceiling that does not add strength to the building structure is not considered a structural ceiling.

1910.303(g)(1)(vii)(B)

Outdoor electric equipment shall be installed in suitable enclosures and shall be protected from accidental contact by unauthorized personnel, or by vehicular traffic, or by accidental spillage or leakage from piping systems. No architectural appurtenance or other equipment may be located in the working space required by paragraph (g)(1)(i) of this section.

1910.303(g)(2)

Guarding of live parts.

1910.303(g)(2)(i)

Except as elsewhere required or permitted by this standard, live parts of electric equipment operating at 50 volts or more shall be guarded against accidentalcontact by use of approved cabinets or other forms of approved enclosures or by any of the following means:

1910.303(g)(2)(i)(A)

By location in a room, vault, or similar enclosure that is accessible only to qualified persons;

1910.303(g)(2)(i)(B)

By suitable permanent, substantial partitions or screens so arranged so that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them;

1910.303(g)(2)(i)(C)

By placement on a suitable balcony, gallery, or platform so elevated and otherwise located as to prevent access by unqualified persons; or

1910.303(g)(2)(i)(D)

By elevation of 2.44 m (8.0 ft) or more above the floor or other working surface.

1910.303(g)(2)(ii)

In locations where electric equipment is likely to be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.

1910.303(g)(2)(iii)

Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

1910.303(h)

Over 600 volts, nominal --

1910.303(h)(1)

General. Conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all applicable provisions of the paragraphs (a) through (g) of this section and with the following provisions, which supplement or modify the preceding requirements. However, paragraphs (h)(2), (h)(3), and (h)(4) of this section do not apply to the equipment on the supply side of the service point.

1910.303(h)(2)

Enclosure for electrical installations.

1910.303(h)(2)(i)

Electrical installations in a vault, room, or closet or in an area surrounded by a wall, screen, or fence, access to which is controlled by lock and key or other approved means, are considered to be accessible to qualified persons only. The type of enclosure used in a given case shall be designed and constructed according to the hazards associated with the installation.

1910.303(h)(2)(ii)

For installations other than equipment described in paragraph (h)(2)(v) of this section, a wall, screen, or fence shall be used to enclose an outdoor electrical installation to deter access by persons who are not qualified. A fence may not be less than 2.13 m (7.0 ft) in height or a combination of 1.80 m (6.0 ft) or more of fence fabric and a 305-mm (1-ft) or

more extension utilizing three or more strands of barbed wire or equivalent.

1910.303(h)(2)(iii)

The following requirements apply to indoor installations that are accessible to other than qualified persons:

1910.303(h)(2)(iii)(A)

The installations shall be made with metal-enclosed equipment or shall be enclosed in a vault or in an area to which access is controlled by a lock;

1910.303(h)(2)(iii)(B)

Metal-enclosed switchgear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment shall be marked with appropriate caution signs; and

1910.303(h)(2)(iii)(C)

Openings in ventilated dry-type transformers and similar openings in other equipment shall be designed so that foreign objects inserted through these openings will be deflected from energized parts.

1910.303(h)(2)(iv)

Outdoor electrical installations having exposed live parts shall be accessible to qualified persons only.

1910.303(h)(2)(v)

The following requirements apply to outdoor enclosed equipment accessible to unqualified employees:

1910.303(h)(2)(v)(A)

Ventilating or similar openings in equipment shall be so designed that foreign objects inserted through these openings will be deflected from energized parts;

1910.303(h)(2)(v)(B)

Where exposed to physical damage from vehicular traffic, suitable guards shall be provided;

1910.303(h)(2)(v)(C)

Nonmetallic or metal-enclosed equipment located outdoors and accessible to the general public shall be designed so that exposed nuts or bolts cannot be readily removed, permitting access to live parts;

1910.303(h)(2)(v)(D)

Where nonmetallic or metal-enclosed equipment is accessible to the general public and the bottom of the enclosure is less than 2.44 m (8.0 ft) above the floor or grade level, the enclosure door or hinged cover shall be kept locked; and

1910.303(h)(2)(v)(E)

Except for underground box covers that weigh over 45.4 kg (100 lb), doors and covers of enclosures used solely as pull boxes, splice boxes, or junction boxes shall be locked, bolted, or screwed on.

1910.303(h)(3)

Work space about equipment. Sufficient space shall be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment. Where energized parts are exposed, the minimum clear work space may not be less than 1.98 m (6.5 ft) high (measured vertically from the floor or platform) or less than 914 mm (3.0 ft) wide (measured parallel to the equipment). The depth shall be as required in paragraph (h)(5)(i) of this section. In all cases, the work space shall be adequate to permit at least a 90-degree opening of doors or hinged panels.

1910.303(h)(4)

Entrance and access to work space.

1910.303(h)(4)(i)

At least one entrance not less than 610 mm (24 in.) wide and 1.98 m (6.5 ft) high shall be provided to give access to the working space about electric equipment.

1910.303(h)(4)(i)(A)

On switchboard and control panels exceeding 1.83 m (6.0 ft) in width, there shall be one entrance at each end of such boards unless the location of the switchboards and control panels permits a continuous and unobstructed way of exit travel, or unless the work space required in paragraph (h)(5)(i) of this section is doubled.

1910.303(h)(4)(i)(B)

Where one entrance to the working space is permitted under the conditions described in paragraph (h)(4)(i)(A) of this section, the entrance shall be located so that the edge of the entrance nearest the switchboards and control panels is at least the minimum clear distance given in Table S-2 away from such equipment.

1910.303(h)(4)(i)(C)

Where bare energized parts at any voltage or insulated energized parts above 600 volts, nominal, to ground are located adjacent to such entrance, they shall be suitably guarded.

1910.303(h)(4)(ii)

Permanent ladders or stairways shall be provided to give safe access to the working space around electric equipment installed on platforms, balconies, mezzanine floors, or in attic or roof rooms or spaces.

1910.303(h)(5)

Working space and guarding.

1910.303(h)(5)(i)

(vi) Except as elsewhere required or permitted in this subpart, the minimum clear working space in the direction of access to live parts of electric equipment may not be less than specified in Table S-2. Distances shall be measured from the live parts, if they are exposed, or from the enclosure front or opening, if they are enclosed.

1910.303(h)(5)(ii)

If switches, cutouts, or other equipment operating at 600 volts, nominal, or less, are installed in a room or enclosure where there are exposed live parts or exposed wiring operating at over 600 volts, nominal, the high-voltage equipment shall be effectively separated from the space occupied by the low-voltage equipment by a suitable partition, fence, or screen. However, switches or other equipment operating at 600 volts, nominal, or less, and serving only equipment within the high-voltage vault, room, or enclosure may be installed in the high-voltage enclosure, room, or vault if accessible to qualified persons only.

1910.303(h)(5)(iii)

The following requirements apply to the entrances to all buildings, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 volts, nominal:

1910.303(h)(5)(iii)(A)

The entrances shall be kept locked unless they are under the observation of a qualified person at all times; and

1910.303(h)(5)(iii)(B)

Permanent and conspicuous warning signs shall be provided, reading substantially as follows:

"DANGER -- HIGH VOLTAGE -- KEEP OUT."

1910.303(h)(5)(iv)

Illumination shall be provided for all working spaces about electric equipment.

1910.303(h)(5)(iv)(A)

The lighting outlets shall be arranged so that persons changing lamps or making repairs on the lighting system will not be endangered by live parts or other equipment.

1910.303(h)(5)(iv)(B)

The points of control shall be located so that persons are prevented from contacting any live part or moving part of the equipment while turning on the lights.

1910.303(h)(5)(v)

Unguarded live parts above working space shall be maintained at elevations not less than specified in Table S-3.

1910.303(h)(5)(vi)

Pipes or ducts that are foreign to the electrical installation and that require periodic

maintenance or whose malfunction would endanger the operation of the electrical system may not be located in the vicinity of service equipment, metal-enclosed power switchgear, or industrial control assemblies. Protection shall be provided where necessary to avoid damage from condensation leaks and breaks in such foreign systems.

Note to paragraph (h)(5)(vi) of this section: Piping and other facilities are not considered foreign if provided for fire protection of the electrical installation.

Table S-2. -- Minimum Depth of Clear Working Space at Electric Equipment, Over 600 V

Nominal voltage to ground	Minimum clear distance for condition[2] [3]					
	Condition A		Condition B		Condition B	
	m	ft	m	ft	m	ft
601-2500 V	0.9	3.0	1.2	4.0	1.5	5.0
2501-9000 V	1.2	4.0	1.5	5.0	1.8	6.0
9001 V-25 kV	1.5	5.0	1.8	6.0	2.8	9.0
Over 25-75 kV[1]	1.8	6.0	2.5	8.0	3.0	10.0
Above 75 kV[1]	2.5	8.0	3.0	10.0	3.7	12.0

Notes to Table S-2:

[1] Minimum depth of clear working space in front of electric equipment with a nominal voltage to ground above 25,000 volts may be the same as that for 25,000 volts under Conditions A, B, and C for installations built before April 16, 1981.

[2] Conditions A, B, and C are as follows:

Condition A -- Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.

Condition B -- Exposed live parts on one side and grounded parts on the other side. Concrete, brick, and tile walls are considered as grounded surfaces.

Condition C -- Exposed live parts on both sides of the work space (not guarded as provided in Condition A) with the operator between.

[3] Working space is not required in back of equipment such as dead-front switchboards or control assemblies that has no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on the deenergized parts on the back of enclosed equipment, a minimum working space 762 mm (30 in.) horizontally shall be provided.

Table S-3. -- Elevation of Unguarded Live Parts Above Working Space

Nominal voltage between phases	Elevation	
	m	ft
601-7500 V	[1]2.81	[1]9.01
7501 V-35 kV	2.8	9.0
Over 35 kV	2.8 + 9.5 mm/kV over 35 kV	9.0 + 0.37 in./kV over 35 kV

[1]The minimum elevation may be 2.6 m (8.5 ft) for installations built before August 13, 2007. The minimum elevation may be 2.4 m (8.0 ft) for installations built before April 16, 1981, if the nominal voltage between phases is in the range of 601-6600 volts.

[46 FR 4056, Jan. 16, 1981; 46 FR 40185, Aug. 7, 1981; 72 FR 7191, Feb. 14, 2007]

Next Standard (1910.304)

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Regulations (Standards - 29 CFR)

Hand Protection. - 1910.138

Regulations (Standards - 29 CFR) - Table of Contents

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** I
- **Subpart Title:** Personal Protective Equipment
- **Standard Number:** 1910.138
- **Title:** Hand Protection.

1910.138(a)

General requirements. Employers shall select and require employees to use appropriate hand protection when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes.

1910.138(b)

Selection. Employers shall base the selection of the appropriate hand protection on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified.

[59 FR 16362, April 6, 1994]

Next Standard (1910 Subpart I App A)

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Regulations (Standards - 29 CFR)

Occupational foot protection. - 1910.136

Regulations (Standards - 29 CFR) - Table of Contents

• **Part Number:**	1910
• **Part Title:**	Occupational Safety and Health Standards
• **Subpart:**	I
• **Subpart Title:**	Personal Protective Equipment
• **Standard Number:**	1910.136
• **Title:**	Occupational foot protection.

1910.136(a)

General requirements. The employer shall ensure that each affected employee uses protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where such employee's feet are exposed to electrical hazards.

1910.136(b)

Criteria for protective footwear.

1910.136(b)(1)

Protective footwear purchased after July 5, 1994 shall comply with ANSI Z41-1991, "American National Standard for Personal Protection-Protective Footwear," which is incorporated by reference as specified in Sec. 1910.6, or shall be demonstrated by the employer to be equally effective.

1910.136(b)(2)

Protective footwear purchased before July 5, 1994 shall comply with the ANSI standard "USA Standard for Men's Safety-Toe Footwear," Z41.1-1967, which is incorporated by reference as specified in Sec. 1910.6, or shall be demonstrated by the employer to be equally effective.

[59 FR 16360, April 6, 1994; 59 FR 33910, July 1, 1994; 61 FR 9227, March 7, 1996; 61 FR 19547, May 2, 1996; 61 FR 21228, May 9, 1996]

Next Standard (1910.137)

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Regulations (Standards - 29 CFR)

Head protection. - 1910.135

Regulations (Standards - 29 CFR) - Table of Contents

• **Part Number:**	1910
• **Part Title:**	Occupational Safety and Health Standards
• **Subpart:**	I
• **Subpart Title:**	Personal Protective Equipment
• **Standard Number:**	1910.135
• **Title:**	Head protection.

1910.135(a)

General requirements.

1910.135(a)(1)

The employer shall ensure that each affected employee wears a protective helmet when working in areas where there is a potential for injury to the head from falling objects.

1910.135(a)(2)

The employer shall ensure that a protective helmet designed to reduce electrical shock hazard is worn by each such affected employee when near exposed electrical conductors which could contact the head.

1910.135(b)

Criteria for protective helmets.

1910.135(b)(1)

Protective helmets purchased after July 5, 1994 shall comply with ANSI Z89.1-1986, "American National Standard for Personnel Protection-Protective Headwear for Industrial Workers-Requirements,"which is incorporated by reference as specified in Sec. 1910.6, or shall be demonstrated to be equally effective.

1910.135(b)(2)

Protective helmets purchased before July 5, 1994 shall comply with the ANSI standard "American National Standard Safety Requirements for Industrial Head Protection," ANSI Z89.1-1969, which is incorporated by reference as specified in Sec. 1910.6, or shall be demonstrated by the employer to be equally effective.

[59 FR 16362, April 6, 1994; 61 FR 9227, March 7, 1996; 61 FR 19547, May 1, 1996]

Next Standard (1910.136)

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Regulations (Standards - 29 CFR)

Eye and face protection. - 1910.133

Regulations (Standards - 29 CFR) - Table of Contents

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** I
- **Subpart Title:** Personal Protective Equipment
- **Standard Number:** 1910.133
- **Title:** Eye and face protection.

1910.133(a)

General requirements.

1910.133(a)(1)

The employer shall ensure that each affected employee uses appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.

1910.133(a)(2)

The employer shall ensure that each affected employee uses eye protection that provides side protection when there is a hazard from flying objects. Detachable side protectors (e.g. clip-on or slide-on side shields) meeting the pertinent requirements of this section are acceptable.

1910.133(a)(3)

The employer shall ensure that each affected employee who wears prescription lenses while engaged in operations that involve eye hazards wears eye protection that incorporates the prescription in its design, or wears eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.

1910.133(a)(4)

Eye and face PPE shall be distinctly marked to facilitate identification of the manufacturer.

..1910.133(a)(5)

1910.133(a)(5)

The employer shall ensure that each affected employee uses equipment with filter lenses that have a shade number appropriate for the work being performed for protection from injurious light radiation. The following is a listing of appropriate shade numbers for various operations.

Filter Lenses for Protection Against Radiant Energy

Operations	Electrode Size 1/32 in.	Arc Current	Minimum(*) Protective Shade
Shielded metal arc welding	Less than 3	Less than 60 ...	7
	3-5	60-160	8
	5-8	160-250	10
	More than 8	250-550	11
Gas metal arc welding and flux cored arc welding		less than 60 ...	7
		60-160	10
		160-250	10
		250-500	10
Gas Tungsten arc welding		less than 50 ...	8
		50-150	8
		150-500	10
Air carbon Arc cutting	(Light)	less than 500 ..	10
	(Heavy)	500-1000	11
Plasma arc welding		less than 20 ...	6
		20-100	8
		100-400	10
		400-800	11
Plasma arc cutting	(light)(**)	less than 300 ..	8
	(medium)(**)	300-400	9
	(heavy)(**)	400-800	10
Torch brazing		.....	3
Torch soldering		.....	2
Carbon arc welding		.....	14

Filter Lenses for Protection Against Radiant Energy

Operations	Plate thickness-inches	Plate thickness-mm	Minimum(*) Protective Shade
Gas Welding:			
Light	Under 1/8	Under 3.2	4
Medium	1/8 to 1/2	3.2 to 12.7	5
Heavy	Over 1/2	Over 12.7	6
Oxygen cutting:			

Light	Under 1	Under 25	3
Medium	1 to 6	25 to 150	4
Heavy	Over 6	Over 150	5

Footnote(*) As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.

Footnote(**) These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the workpiece.

1910.133(b)

Criteria for protective eye and face devices.

1910.133(b)(1)

Protective eye and face devices purchased after July 5, 1994 shall comply with ANSI Z87.1-1989, "American National Standard Practice for Occupational and Educational Eye and Face Protection," which is incorporated by reference as specified in Sec. 1910.6.

1910.133(b)(2)

Eye and face protective devices purchased before July 5, 1994 shall comply with the ANSI "USA standard for Occupational and Educational Eye and Face Protection," Z87.1-1968, which is incorporated by reference as specified in Sec. 1910.6, or shall be demonstrated by the employer to be equally effective.

[59 FR 16360, April 6, 1994; 59 FR 33910, July 1, 1994; 61 FR 9227, March 7, 1996; 61 FR 19547, May 2, 1996]

Next Standard (1910.134)

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Regulations (Standards - 29 CFR)

General requirements. - 1910.132

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- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** I
- **Subpart Title:** Personal Protective Equipment
- **Standard Number:** 1910.132
- **Title:** General requirements.

1910.132(a)

Application. Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

1910.132(b)

Employee-owned equipment. Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

1910.132(c)

Design. All personal protective equipment shall be of safe design and construction for the work to be performed.

..1910.132(d)

1910.132(d)

Hazard assessment and equipment selection.

1910.132(d)(1)

The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall:

1910.132(d)(1)(i)

Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment;

1910.132(d)(1)(ii)

Communicate selection decisions to each affected employee; and,

1910.132(d)(1)(iii)

Select PPE that properly fits each affected employee. Note: Non-mandatory Appendix B contains an example of procedures that would comply with the requirement for a hazard assessment.

1910.132(d)(2)

The employer shall verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and, which identifies the document as a certification of hazard assessment.

1910.132(e)

Defective and damaged equipment. Defective or damaged personal protective equipment shall not be used.

..1910.132(f)

1910.132(f)

Training.

1910.132(f)(1)

The employer shall provide training to each employee who is required by this section to use PPE. Each such employee shall be trained to know at least the following:

1910.132(f)(1)(i)

When PPE is necessary;

1910.132(f)(1)(ii)

What PPE is necessary;

1910.132(f)(1)(iii)

How to properly don, doff, adjust, and wear PPE;

1910.132(f)(1)(iv)

The limitations of the PPE; and,

1910.132(f)(1)(v)

The proper care, maintenance, useful life and disposal of the PPE.

1910.132(f)(2)

Each affected employee shall demonstrate an understanding of the training specified in paragraph (f)(1) of this section, and the ability to use PPE properly, before being allowed to perform work requiring the use of PPE.

1910.132(f)(3)

When the employer has reason to believe that any affected employee who has already been trained does not have the understanding and skill required by paragraph (f)(2) of this section, the employer shall retrain each such employee. Circumstances where retraining is required include, but are not limited to, situations where:

1910.132(f)(3)(i)

Changes in the workplace render previous training obsolete; or

..1910.132(f)(3)(ii)

1910.132(f)(3)(ii)

Changes in the types of PPE to be used render previous training obsolete; or

1910.132(f)(3)(iii)

Inadequacies in an affected employee's knowledge or use of assigned PPE indicate that the employee has not retained the requisite understanding or skill.

1910.132(f)(4)

The employer shall verify that each affected employee has received and understood the required training through a written certification that contains the name of each employee trained, the date(s) of training, and that identifies the subject of the certification.

1910.132(g)

Paragraphs (d) and (f) of this section apply only to 1910.133, 1910.135, 1910.136, and 1910.138. Paragraphs (d) and (f) of this section do not apply to 1910.134 and 1910.137.

[39 FR 23502, June 27, 1974, as amended at 59 FR 16334, April 6, 1994; 59 FR 33910, July 1, 1994; 59 FR 34580, July 6, 1994]

Next Standard (1910.133)

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Regulations (Standards - 29 CFR)

Batteries and battery charging. - 1926.441

Regulations (Standards - 29 CFR) - Table of Contents

- **Part Number:** 1926
- **Part Title:** Safety and Health Regulations for Construction
- **Subpart:** K
- **Subpart Title:** Electrical
- **Standard Number:** 1926.441
- **Title:** Batteries and battery charging.

1926.441(a)

General requirements -

1926.441(a)(1)

Batteries of the unsealed type shall be located in enclosures with outside vents or in well ventilated rooms and shall be arranged so as to prevent the escape of fumes, gases, or electrolyte spray into other areas.

1926.441(a)(2)

Ventilation shall be provided to ensure diffusion of the gases from the battery and to prevent the accumulation of an explosive mixture.

1926.441(a)(3)

Racks and trays shall be substantial and shall be treated to make them resistant to the electrolyte.

1926.441(a)(4)

Floors shall be of acid resistant construction unless protected from acid accumulations.

1926.441(a)(5)

Face shields, aprons, and rubber gloves shall be provided for workers handling acids or batteries.

1926.441(a)(6)

Facilities for quick drenching of the eyes and body shall be provided within 25 feet (7.62 m) of battery handling areas.

..1926.441(a)(7)

1926.441(a)(7)

Facilities shall be provided for flushing and neutralizing spilled electrolyte and for fire protection.

1926.441(b)

Charging -

1926.441(b)(1)

Battery charging installations shall be located in areas designated for that purpose.

1926.441(b)(2)

Charging apparatus shall be protected from damage by trucks.

1926.441(b)(3)

When batteries are being charged, the vent caps shall be kept in place to avoid electrolyte spray. Vent caps shall be maintained in functioning condition.

Next Standard (1926.442)

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Regulations (Standards - 29 CFR)

Non-mandatory Compliance Guidelines for Hazard Assessment and Personal Protective Equipment Selection. - 1910 Subpart I App B

Regulations (Standards - 29 CFR) - Table of Contents

• **Part Number:**	1910
• **Part Title:**	Occupational Safety and Health Standards
• **Subpart:**	I
• **Subpart Title:**	Personal Protective Equipment
• **Standard Number:**	1910 Subpart I App B
• **Title:**	Non-mandatory Compliance Guidelines for Hazard Assessment and Personal Protective Equipment Selection.

This Appendix is intended to provide compliance assistance for employers and employees in implementing requirements for a hazard assessment and the selection of personal protective equipment.

1. Controlling hazards. PPE devices alone should not be relied on to provide protection against hazards, but should be used in conjunction with guards, engineering controls, and sound manufacturing practices.

2. Assessment and selection. It is necessary to consider certain general guidelines for assessing the foot, head, eye and face, and hand hazard situations that exist in an occupational or educational operation or process, and to match the protective devices to the particular hazard. It should be the responsibility of the safety officer to exercise common sense and appropriate expertise to accomplish these tasks.

3. Assessment guidelines. In order to assess the need for PPE the following steps should be taken:

a. Survey. Conduct a walk-through survey of the areas in question. The purpose of the survey is to identify sources of hazards to workers and co-workers. Consideration should be given to the basic hazard categories:

(a) Impact

(b) Penetration

(c) Compression (roll-over)

(d) Chemical

(e) Heat

(f) Harmful dust

(g) Light (optical) radiation

b. Sources. During the walk-through survey the safety officer should observe:

(a) sources of motion; i.e., machinery or processes where any movement of tools, machine elements or particles could exist, or movement of personnel that could result in collision with stationary objects;

(b) sources of high temperatures that could result in burns, eye injury or ignition of protective equipment, etc.;

(c) types of chemical exposures;

(d) sources of harmful dust;

(e) sources of light radiation, i.e., welding, brazing, cutting, furnaces, heat treating, high intensity lights, etc.;

(f) sources of falling objects or potential for dropping objects;

(g) sources of sharp objects which might pierce the feet or cut the hands;

(h) sources of rolling or pinching objects which could crush the feet;

(i) layout of workplace and location of co-workers; and (j) any electrical hazards. In addition, injury/accident data should be reviewed to help identify problem areas.

c. Organize data. Following the walk-through survey, it is necessary to organize the data and information for use in the assessment of hazards. The objective is to prepare for an analysis of the hazards in the environment to enable proper selection of protective equipment.

d. Analyze data. Having gathered and organized data on a workplace, an estimate of the potential for injuries should be made. Each of the basic hazards (paragraph 3.a.) should be reviewed and a determination made as to the type, level of risk, and seriousness of potential injury from each of the hazards found in the area. The possibility of exposure to several hazards simultaneously should be considered.

4. Selection guidelines. After completion of the procedures in paragraph 3, the general procedure for selection of protective equipment is to:

(a) Become familiar with the potential hazards and the type of protective equipment that is available, and what it can do; i.e., splash protection, impact protection, etc.;

(b) compare the hazards associated with the environment; i.e., impact velocities, masses, projectile shape, radiation intensities, with the capabilities of the available protective equipment;

(c) select the protective equipment which ensures a level of protection greater than the minimum required to protect employees from the hazards; and

(d) fit the user with the protective device and give instructions on care and use of the PPE. It is very important that end users be made aware of all warning labels for and limitations of their PPE.

5. Fitting the device. Careful consideration must be given to comfort and fit. PPE that fits poorly will not afford the necessary protection. Continued wearing of the device is more likely if it fits the wearer comfortably. Protective devices are generally available in a variety

of sizes. Care should be taken to ensure that the right size is selected.

6. Devices with adjustable features. Adjustments should be made on an individual basis for a comfortable fit that will maintain the protective device in the proper position. Particular care should be taken in fitting devices for eye protection against dust and chemical splash to ensure that the devices are sealed to the face. In addition, proper fitting of helmets is important to ensure that it will not fall off during work operations. In some cases a chin strap may be necessary to keep the helmet on an employee's head. (Chin straps should break at a reasonably low force, however, so as to prevent a strangulation hazard). Where manufacturer's instructions are available, they should be followed carefully.

7. Reassessment of hazards. It is the responsibility of the safety officer to reassess the workplace hazard situation as necessary, by identifying and evaluating new equipment and processes, reviewing accident records, and reevaluating the suitability of previously selected PPE.

8. Selection chart guidelines for eye and face protection. Some occupations (not a complete list) for which eye protection should be routinely considered are: carpenters, electricians, machinists, mechanics and repairers, millwrights, plumbers and pipe fitters, sheet metal workers and tinsmiths, assemblers, sanders, grinding machine operators, lathe and milling machine operators, sawyers, welders, laborers, chemical process operators and handlers, and timber cutting and logging workers. The following chart provides general guidance for the proper selection of eye and face protection to protect against hazards associated with the listed hazard "source" operations.

Eye and Face Protection Selection Chart

Source	Assessment of Hazard	Protection
IMPACT - Chipping, grinding machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding.	Flying fragments, objects, large chips, particles sand, dirt, etc. ..	Spectacles with side protection, goggles, face shields. See notes (1), (3), (5), (6), (10). For severe exposure, use faceshield.
HEAT-Furnace operations, pouring, casting, hot dipping, and welding.	Hot sparks	Faceshields, goggles, spectacles with side protection. For severe exposure use faceshield. See notes (1), (2), (3).
	Splash from molten metals.....	Faceshields worn over goggles. See notes (1), (2), (3).
	High temperature exposure.....	Screen face shields, reflective face shields. See notes (1), (2), (3).
CHEMICALS-Acid and chemicals handling, degreasing plating.	Splash	Goggles, eyecup and cover types. For severe exposure,

		use face shield. See notes (3), (11).
	Irritating mists ..	Special-purpose goggles.
DUST - Woodworking, buffing, general dusty conditions.	Nuisance dust	Goggles, eyecup and cover types. See note (8).
LIGHT and/or RADIATION - Welding: Electric arc	Optical radiation .	Welding helmets or welding shields. Typical shades: 10-14. See notes (9), (12).
Welding: Gas	Optical radiation .	Welding goggles or welding face shield. Typical shades: gas welding 4-8, cutting 3-6, brazing 3-4. See note (9).
Cutting, Torch brazing, Torch soldering	Optical radiation ..	Spectacles or welding face-shield. Typical shades, 1.5-3. See notes (3), (9).
Glare	Poor vision	Spectacles with shaded or special-purpose lenses, as suitable. See notes (9), (10).

Notes to Eye and Face Protection Selection Chart:

(1) Care should be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards should be provided. Protective devices do not provide unlimited protection.

(2) Operations involving heat may also involve light radiation. As required by the standard, protection from both hazards must be provided.

(3) Faceshields should only be worn over primary eye protection (spectacles or goggles).

(4) As required by the standard, filter lenses must meet the requirements for shade designations in 1910.133(a)(5). Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.

(5) As required by the standard, persons whose vision requires the use of prescription (Rx) lenses must wear either protective devices fitted with prescription (Rx) lenses or protective devices designed to be worn over regular prescription (Rx) eyewear.

(6) Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.

(7) Caution should be exercised in the use of metal frame protective devices in electrical hazard areas.

(8) Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.

(9) Welding helmets or faceshields should be used only over primary eye protection (spectacles or goggles).

(10) Non-sideshield spectacles are available for frontal protection

only, but are not acceptable eye protection for the sources and operations listed for "impact."
(11) Ventilation should be adequate, but well protected from splash entry. Eye and face protection should be designed and used so that it provides both adequate ventilation and protects the wearer from splash entry.
(12) Protection from light radiation is directly related to filter lens density. See note (4) . Select the darkest shade that allows task performance.

9. Selection guidelines for head protection. All head protection (helmets) is designed to provide protection from impact and penetration hazards caused by falling objects. Head protection is also available which provides protection from electric shock and burn. When selecting head protection, knowledge of potential electrical hazards is important. Class A helmets, in addition to impact and penetration resistance, provide electrical protection from low-voltage conductors (they are proof tested to 2,200 volts). Class B helmets, in addition to impact and penetration resistance, provide electrical protection from high-voltage conductors (they are proof tested to 20,000 volts). Class C helmets provide impact and penetration resistance (they are usually made of aluminum which conducts electricity), and should not be used around electrical hazards.

Where falling object hazards are present, helmets must be worn. Some examples include: working below other workers who are using tools and materials which could fall; working around or under conveyor belts which are carrying parts or materials; working below machinery or processes which might cause material or objects to fall; and working on exposed energized conductors. Some examples of occupations for which head protection should be routinely considered are: carpenters, electricians, linemen, mechanics and repairers, plumbers and pipe fitters, assemblers, packers, wrappers, sawyers, welders, laborers, freight handlers, timber cutting and logging, stock handlers, and warehouse laborers.

10. Selection guidelines for foot protection. Safety shoes and boots which meet the ANSI Z41-1991 Standard provide both impact and compression protection. Where necessary, safety shoes can be obtained which provide puncture protection. In some work situations, metatarsal protection should be provided, and in other special situations electrical conductive or insulating safety shoes would be appropriate.

Safety shoes or boots with impact protection would be required for carrying or handling materials such as packages, objects, parts or heavy tools, which could be dropped; and, for other activities where objects might fall onto the feet. Safety shoes or boots with compression protection would be required for work activities involving skid trucks (manual material handling carts) around bulk rolls (such as paper rolls) and around heavy pipes, all of which could potentially roll over an employee's feet. Safety shoes or boots with puncture protection would be required where sharp objects such as nails, wire, tacks, screws, large staples, scrap metal etc., could be stepped on by employees causing a foot injury.

Some occupations (not a complete list) for which foot protection should be routinely considered are: shipping and receiving clerks, stock clerks, carpenters, electricians, machinists, mechanics and repairers, plumbers and pipe fitters, structural metal workers, assemblers, drywall installers and lathers, packers, wrappers, craters, punch and stamping press operators, sawyers, welders, laborers, freight handlers, gardeners and grounds-keepers, timber cutting and logging workers, stock handlers and warehouse laborers.

11. Selection guidelines for hand protection. Gloves are often relied upon to prevent cuts, abrasions, burns, and skin contact with chemicals that are capable of causing local or systemic effects following dermal exposure. OSHA is unaware of any gloves that provide

protection against all potential hand hazards, and commonly available glove materials provide only limited protection against many chemicals. Therefore, it is important to select the most appropriate glove for a particular application and to determine how long it can be worn, and whether it can be reused.

It is also important to know the performance characteristics of gloves relative to the specific hazard anticipated; e.g., chemical hazards, cut hazards, flame hazards, etc. These performance characteristics should be assessed by using standard test procedures. Before purchasing gloves, the employer should request documentation from the manufacturer that the gloves meet the appropriate test standard(s) for the hazard(s) anticipated. Other factors to be considered for glove selection in general include:

(A) As long as the performance characteristics are acceptable, in certain circumstances, it may be more cost effective to regularly change cheaper gloves than to reuse more expensive types; and,

(B) The work activities of the employee should be studied to determine the degree of dexterity required, the duration, frequency, and degree of exposure of the hazard, and the physical stresses that will be applied.

With respect to selection of gloves for protection against chemical hazards:

(A) The toxic properties of the chemical(s) must be determined; in particular, the ability of the chemical to cause local effects on the skin and/or to pass through the skin and cause systemic effects;

(B) Generally, any "chemical resistant" glove can be used for dry powders;

(C) For mixtures and formulated products (unless specific test data are available), a glove should be selected on the basis of the chemical component with the shortest breakthrough time, since it is possible for solvents to carry active ingredients through polymeric materials; and,

(D) Employees must be able to remove the gloves in such a manner as to prevent skin contamination.

12. Cleaning and maintenance. It is important that all PPE be kept clean and properly maintained. Cleaning is particularly important for eye and face protection where dirty or fogged lenses could impair vision.

For the purposes of compliance with 1910.132 (a) and (b), PPE should be inspected, cleaned, and maintained at regular intervals so that the PPE provides the requisite protection. It is also important to ensure that contaminated PPE which cannot be decontaminated is disposed of in a manner that protects employees from exposure to hazards.

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Next Standard (1910 Subpart J)

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